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TRANSCO TEST REPORT TR-III

FIRE AND HOSE STREAM TESTS OF TCO-002 MEDIUM DENSITY SILICONE ELASTOMER

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A) Synopsis:

This report describes a three hour fire and subsequent hose stream floor test of Transco #TCO-002 Medium Density Silicone Elastomer installed 12" deep in three electrical openings. The test was performed in accordance with the ASTM E-119 time/temperature curve for three hours along with provisions set forth in the IEEE 634-78, ANI, NML, and ASTM E-814 (for a "F" rating) test standards. These penetration seals were tested along with twenty-four other penetration seals in a 17'-9" x 13'-10-1/2" x 12" thick concrete slab on March 9, 1983 at Portland Cement Association's Fire Research Laboratory (Skokie, Illinois).

The test specimens consisted of three simulated electrical openings which measured 52-1/2" x 32" (penetrated by two 30" x 4" and one 24" x 6" cable trays and two conduits) and 1-1/2" and 6" diameter embedded conduits. All trays and conduits were filled in excess of 100% loadings with PVC jacketed cables (with the exception of the 24" x 6" tray which was filled with Hypalon jacketed cables).

The symmetrical penetration seals consisted of 12" of #TCO-002 Medium Density Silicone Elastomer (no permanent damming material was used). The elastomer weighs 90 lbs./cubic foot (min.) and is normally used for sealing penetrations in flood boundaries and radiation shield walls or floors.

The purpose of this test was not only to demonstrate the elastomer's fire endurance qualities as a penetration seal when used in electrical openings but also to qualify the use of a cast-in-place core which was filled with a removable plug made of ceramic blanket* (see attached drawings). In field use, this plug can easily be removed for the addition of cables through the penetration. This was demonstrated in the test when two of three plugs were removed for the addition of cables (in order to simulate a repair to the seal). The remaining space around these cables was sealed with additional elastomer.

Besides qualifying the seals to the test standards mentioned, several other objectives were established in this test. These are:

1) The material's ability to seal both narrow and wide areas without support;
2) The use of the material when installed next to either steel or concrete substrates;
3) The use of the material to seal both solid and ladder back cable trays;
4) The ability of the sealing material to be removed for additional cable installation (use of temporary plugs); and,
5) That a symmetrical 12" thick seal can withstand the 3 hour fire and 2 hose stream tests.

*Patent applied for

B.) Test Slab:

The test slab measured 17'-9" x 13'-10-1/2" x 12" thick. Twenty-seven openings which ranged from 1-1/2" diameter to 109-1/2" x 32" in size penetrated the test slab. The penetrations were arranged in the slab so that 18" wide (min.) concrete columns separated each row of penetrations. These columns were placed in the direction which would allow for the least amount of deflection from heat during the fire test.

The slab's steel reinforcement design and slab fabrication were completed by Portland Cement Association's personnel. After the slab was cast, the concrete was allowed to dry for several days after which the slab was subjected to additional heat curing on a furnace.

The slab's superstructure, specimen fabrication and seal installations were performed by Transco employees. The slab's superstructure consisted of steel angle braces mounted to the slab which supported the pipes, cable trays, cables, etc., for the test.

C.) Specimen Configurations:

The large rectangular test penetration was 51-1/2" x 32" x 12" deep. Two sides of the penetration were lined with 1/4" thick steel plate (set at a right angle in the plan view of the penetration). The remaining two substrate surfaces were cast concrete.

This opening was penetrated by three cable trays and a 6" and 2" diameter conduit. Each cable tray was mounted so that it extended 36" above the slab's unexposed surface and 12" below its exposed surface. The conduits were 12" long and was mounted flush inside of the penetration.

One 6" and one 1-1/2" diameter (x 12" long) rigid steel conduits were also cast into the concrete slab outside of the large rectangular opening. These were used to simulate embedded conduits (or sleeves) which pass through walls or floors.

The cable trays and conduits were filled with cables based on loadings which exceeded 100% fills. The loadings were calculated so that a 100% fill was equivalent to 40% of the actual sectional area of the cable trays or conduits. Some of the loadings were increased so that 100% visual loadings were also achieved. Cable lodings were as follows:

A.) 32" x 52-1/2" RECTANGULAR OPENING:

1.) 30" x 4" ladder back tray filled with PVC jacketed cable:

134	2/c #14	0.1372	18.3848
35	12/c #14	0.5329	18.6190
26	1/c, 500MCM	0.7013	18.2359

Total Loading = 55.2397 sq. in.
(115% fill of tray)

2.) 30" x 4" solid back tray filled PVC jacketed cable:

134	2/c #14	0.1372	18.3848
35	12/c #14	0.5329	18.6190
26	1/c, 500MCM	0.7013	18.2359

Total Loading = 55.2397 sq. in.
(115% fill of tray)

*Two 2/c #14 and one 12/C #14 cables were added to this tray as part of the repair to this seal.

3.) 24" x 6" solid back cable tray filled with Hypalon jacketed cable:

12	4 pr.	#20	0.4185	5.0220
2	8 pr.	#16	0.6792	1.3584
1	12 pr.	#16	0.9160	0.9160
2	2/C	#14	0.1839	0.3678
1	3/C	#14	0.2058	0.2058
4	4/C	#14	0.2715	1.0860
3	7/C	#14	0.3717	1.1151
10	9/C	#14	0.4938	4.9380
9	12/C	#14	0.7013	6.3117
6	3/C,	4/0	1.8480	11.0880
2	9/C	#10	0.7697	1.5394
6	3/C,	500MCM	5.2563	31.5378
5	3/C,	1/0	1.6695	8.3475

Total loading = 73.8335 sq. in.
(128% fill of tray)

*One 12/C #14 cable was added to this tray as part of the repair to this seal.

4.) 6" diameter conduit filled with PVC jacketed cable:

30	2/c #14	0.1372	4.1160
8	12/c #14	0.5329	4.2632
7	1/c, 500MCM	0.7013	4.9091

Total Loading = 13.2883 sq.in.
(117.4% fill of conduit)

5.) 2" diameter conduit filled with Hypalon jacketed cable:

1	2/C	#14	0.1839	0 1839
1	12/C	#14	0.7013	0.7013
1	3/C	#6/0	0.7133	0.7133

Total Loading = 1.5985 sq. in.
(127.2% fill of conduit)

B.) 1-1/2" diameter embedded conduit filled with PVC jacketed cable (separate penetration):

3	2/C	#14	0.1372	0.4116
1	12/C	#14	0.5329	0.5329

Total Loading = 0.9445 sq. in.
(113.6% fill of conduit)

C.) 6" diameter embedded conduit filled with PVC jacketed cable (separate penetration):

30	2/C	#14	0.1372	4.1160
8	12/C	#14	0.5329	4.2632
7	1/C	500MCM	0.7013	4.9091

Total Loading = 13.2883 sq.in.
(117.4% fill of conduit)

All cables used in the test extended 36" above the slab's unexposed surface and 12" below its exposed surface. Cables were held to the trays with both compression clamps and metal plates located approximately 12" from the top of each tray. In addition, a threaded rod was used across the bottom of each tray to prevent the cables from being pulled forward during the seal

installation. This was done to simulate field conditions where continuous cable make it impossible in some cases to move the cables apart for seal installation.

The top ends of all cables used inside of the cable trays were covered with silicone adhesive while conduit cable ends were covered with electrical tape. This was done in accordance with IEEE 634-78 requirements.

Finally, the cables used in the conduits were grouped and mounted by type (i.e., power, control and instrument cables). The grouping of power cables in each conduit sleeve created a more severe condition because of the high concentation of heat that would be produced during the fire test.

D.) Seal Installation

The openings were first dammed by packing mineral wool between the cables to prevent leakage of the liquid silicone elastomer material. The rest of the opening was formed with plywood. Once the elastomer was installed and set, all forming materials were removed.

As part of the damming operation, round 2" diameter (approximately) foam rubber tubes were placed in front of the 24" x 6" Hypalon cable tray and 30" x 4" PVC cable solid back cable trays. These were used so that once the elastomer was installed and had hardened, the tubes could be easily removed to produce clean, empty cores through the elastomer seal.

The empty core in front of the Hypalon tray was used to add cable to the tray to simulate field addition of cable once the penetration seal is in place. The same was completed for one of two empty cores for the tray with PVC cables. Additional elastomer was used to seal these two cores around the new cable.

The third core (in front of the PVC cable tray) was filled with ceramic blanket. This was held in place by using a threaded rod through the center of the core and securing it with washers and nuts on each side of the penetration seal. This was done to simulate a removable plug (in place) which could later be removed (in the field) for the addition of cables through an existing seal.

The two-component silicone elastomer was installed in a one to one ratio (+/- 5%) 12" deep inside of the large penetration and conduits. A portion of the seal was installed using dispensing equipment while the remainder of the seal was completed with large (30 gallon drum) hand mixed batches. Where the elastomer was used in cable bundles, the bundles were spread apart by hand. A trowel was used to push the elastomer into the cable bundles to facilitate its flow.

Once the elastomer installation was completed, the damming material was removed. It was noted at this time that a small layer of material at the elastomer/PVC jacketed cable interface

did not completely cure. This inhibition of cure at the PVC surfaces was attributed to the free sulphur in the PVC material. Sulphur is a material which affects the curing mechanism of the platinum catalyst silicone product. Although the amount of inhibition varied from PVC jacketed cable to cable, none was immediately observed at the silicone elastomer/hypalon jacketed cable interfaces. No attempt was made to repair the seal where inhibition occurred in order to show both conditions.

E.) Thermocouples:

Thermocouples were mounted to the test specimens to gather temperature data throughout the test at five minute intervals for the first two hours and at ten minute intervals for the remaining hour (in accordance with the IEEE 634-78 standard). Temperatures were recorded for the seal surfaces, seal/substrate interfaces (unexposed surface only), and penetrating members.

All seal surface thermocouples were embedded 1/4"-1/2" into seal surfaces to prevent the effect of contact with ambient air temperatures. Thermocouples used for monitoring cable temperatures were tied with wire to the cables so that their tips were also embedded into the seal surface.

The thermocouples used in this test along with final temperature readings are as follows (temperature data for the entire test can be found in section "H" of this report):

T/C#	Print#	Description	Final Temperature (°F)	
118	57a	Seal surface	82.6	
119	78a	Seal surface	89.1	
120	78a	Seal surface	94.4	
121	72a	Instrument cable	126.5	Solid back cable
122	73a	Control cable	200.6	tray with Hypalon
123	74a	Power cable	202.7	jacketed cable
124	75a	Cable tray	243.2	
125	62a	Seal surface	71.3	
126	63a	Interface	295.8	Hypalon jacketed
127	64a	Instrument cable	225.8	cable conduit
128	65a	Control cable	264.1	
129	70a	Power cable	277.5	
130	58a	Instrument cable	296.3	Solid back cable
131	60a	Control cable	246.1	tray with PVC
132	59a	Power cable	549.8	jacketed cable
133	61a	Cable tray	154.5	
134	95b	Instrument cable	242.9	
135	96b	Control cable	None	Ladder back cable
136	80a	Power cable	461.0	tray with PVC
137	50b	Cable tray	195.3	jacketed cable
138	76a	Concrete substrate/ seal interface	None	
139	77a	Steel substrate/ seal interface	175.4	

T/C#	Print#	Description	Final Temperature (°F)	
140	67a	Seal surface	448.2	
141	66a	Interface	339.6	PVC jacketed
142	68a	Instrument cable	337.5	cable conduit
168	69a	Control cable	444.1	
169	71a	Power cable	410.9	
217	91b	Repair surface	114.6	Hypalon tray
218	92b	Repair cable	None	repair
219	93b	Repair surface	107.2	PVC tray
220	94b	Repair cable	133.3	repair
83	33a	Seal surface	94.8	1-1/2" diameter
84	34a	Interface	111.3	conduit
85	35a	Control cable	184.6	
86	61b	Seal surface	311.4	
87	62b	Instrument cable	335.3	6" diameter embed-
88	64b	Power cable	509.4	ded conduit
90	65b	Interface	337.6	

F.) Furnace:

The furnace used for this test measures approximately 14' x 18' at its support points. It is approximately 7' tall making it possible to work on the specimen's exposed surface and view it prior to the fire test. The furnace atmosphere is controlled by six self-igniting burners which burn natural gas and operate in unison. The burners are automatically controlled by a computer located inside of the control room. As the furnace atmosphere temperatures are monitored in the control room, manual adjustments can be made to the burners to account for varying amounts of fuel contribution throughout the test.

The furnace atmosphere temperatures are monitored by 16 thermocouples located 12" below the test slab. These temperatures are individually printed on a continuous chart and also averaged on a computer printout.

The furnace draft is manually operated and averages to approximately -.08" of water pressure throughout the test. Since manual adjustments are made to the burners in order to follow the ASTM E-119 time/temperature curve, brief periods of positive pressure are introduced inside of the furnace. This is evidenced by visible puffs of smoke generated through openings in the test specimen (i.e., through a fire damper, unsealed pipe insulation, etc.).

G.) Test Record:

The fire test was conducted for three hours in accordance with the ASTM E-119 time/temperature curve. Throughout the test, an even blanket of flame covered the plan area of the furnace. All combustible materials located on the exposed surface of the slab (i.e., cable jacketing material, etc.) quickly ignited and continued to char for the duration of the test. Little smoke was noted during the test and all seal surface temperatures remained relatively cool.

Two separate hose stram tests were conducted on the three specimens. Water did not penetrate any of the seals during either of the 6 minute and 18 second long exposures. The hose stream tests conducted are as follows:

a.) IEEE-634-78: 75 p.s.i. hose stream delivered through an 1-1/2" hose equipped with a fog nozzle set at a discharge of 30° from a distance of 10'.

b.) ANI: Same as above except that the nozzle was set at a discharge angle of 15°.

H.) Temperature Data:

The following sheets identify both complete furnace atmosphere and unexposd surface temperatures throughout the three hour fire test.

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FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	196	68	128
0:05	995	1000	-5
0:10	1271	1300	-29
0:15	1503	1399	104
0:20	1527	1462	65
0:25	1547	1510	37
0:30	1557	1550	7
0:35	1608	1584	24
0:40	1626	1613	13
0:45	1638	1638	0
0:50	1655	1661	-6
0:55	1704	1681	23
1:00	1714	1700	14
1:05	1724	1718	6
1:10	1729	1735	-6
1:15	1748	1750	-2
1:20	1771	1765	6
1:25	1776	1779	-3
1:30	1779	1792	-13
1:35	1818	1804	14
1:40	1823	1815	8
1:45	1830	1826	4
1:50	1836	1835	1
1:55	1844	1843	1
2:00	1854	1850	4
2:10	1873	1862	11
2:20	1880	1875	5
2:30	1880	1888	-8
2:40	1895	1900	-5
2:50	1916	1912	4
3:00	1930	1925	5

TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)					
	118	119	120	121	122	123
0:00	71.9	72.3	71.8	71.9	72.2	71.8
0:05	71.9	72.3	71.9	71.9	72.3	71.8
0:10	72.0	72.3	71.8	71.9	72.8	71.9
0:15	72.0	72.3	71.9	72.0	74.2	72.2
0:20	72.0	72.3	71.8	72.0	76.2	72.6
0:25	72.4	72.4	72.1	72.2	78.7	73.5
0:30	72.8	72.5	72.1	72.3	81.2	74.5
0:35	73.2	72.7	72.3	72.8	83.9	76.0
0:40	73.6	72.9	72.5	73.2	86.9	77.7
0:45	74.4	73.1	72.8	73.9	90.3	79.7
0:50	75.0	73.3	73.1	74.5	93.9	82.0
0:55	75.8	73.6	73.4	75.4	97.8	84.5
1:00	76.4	73.9	73.9	76.4	102.1	87.5
1:05	76.8	74.2	74.3	77.4	106.3	90.5
1:10	77.6	74.6	74.8	78.8	110.6	93.9
1:15	78.6	75.1	75.4	80.2	115.9	97.7
1:20	78.8	75.6	76.0	81.8	120.5	101.7
1:25	79.9	76.1	76.6	83.5	126.2	105.8
1:30	79.8	76.6	77.2	85.2	132.5	110.0
1:35	81.6	77.2	78.0	87.1	137.1	114.6
1:40	79.8	77.7	78.7	89.0	142.3	119.2
1:45	78.8	78.1	79.4	90.9	149.0	124.0
1:50	79.3	78.7	80.2	92.9	154.8	129.0
1:55	80.2	79.4	81.1	95.2	159.3	134.0
2:00	81.2	80.0	81.9	97.5	165.2	139.1
2:10	80.6	81.2	83.6	101.9	173.8	147.7
2:20	82.4	82.7	85.5	106.8	181.5	159.5
2:30	81.4	84.2	87.5	111.5	187.3	170.1
2:40	80.9	85.8	89.8	116.4	191.9	181.1
2:50	82.2	87.5	92.2	121.6	196.5	191.8
3:00	82.6	89.1	94.4	126.5	200.6	202.7

TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)					
	124	125	126	127	128	129
0:00	71.5	72.1	71.6	71.6	71.6	71.5
0:05	71.5	72.0	71.6	71.7	71.7	71.5
0:10	71.8	72.2	72.0	71.9	72.1	72.1
0:15	72.7	72.3	72.9	72.6	73.1	73.5
0:20	74.3	72.2	74.8	74.0	74.9	75.9
0:25	77.2	72.7	78.1	76.6	78.3	80.3
0:30	80.9	72.9	82.8	80.4	82.8	85.8
0:35	85.9	73.1	88.6	85.2	88.5	92.3
0:40	92.1	73.1	95.3	90.7	95.0	99.7
0:45	99.0	73.6	103.0	97.3	101.9	107.5
0:50	106.2	73.8	110.5	102.9	109.1	115.7
0:55	113.2	74.2	118.6	109.8	116.0	123.9
1:00	120.5	74.2	126.6	116.1	123.2	131.8
1:05	127.4	74.3	134.0	121.8	129.9	139.2
1:10	135.0	74.7	142.0	127.2	137.1	147.0
1:15	142.5	74.8	150.0	134.2	143.8	154.7
1:20	150.2	75.6	157.7	140.4	151.1	162.4
1:25	157.7	75.3	165.0	145.6	157.0	170.0
1:30	165.6	76.0	172.7	151.4	164.5	177.5
1:35	174.0	76.2	180.1	157.0	170.5	184.7
1:40	187.2	74.2	187.7	161.3	178.1	191.8
1:45	196.4	72.9	195.0	166.0	183.7	198.3
1:50	196.1	73.0	201.0	170.7	877.5	202.8
1:55	197.6	73.5	207.1	175.1	190.3	206.7
2:00	207.5	73.1	214.1	179.6	196.2	212.5
2:10	219.6	72.9	233.7	190.3	208.3	224.6
2:20	227.6	73.9	247.8	199.6	215.4	236.4
2:30	229.7	70.9	260.2	205.9	224.3	246.7
2:40	232.9	71.1	272.8	212.8	232.1	257.6
2:50	236.3	71.2	284.3	217.6	240.2	267.7
3:00	243.2	71.3	295.8	225.8	246.1	277.5

TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)					
	130	131	132	133	134	135
0:00	72.3	72.0	73.0	72.2	72.2	NONE
0:05	72.5	72.1	75.6	72.2	72.2	" "
0:10	73.6	72.7	85.1	72.3	72.3	" "
0:15	75.7	74.0	99.5	72.4	72.7	" "
0:20	79.4	76.4	118.3	72.6	73.5	" "
0:25	84.9	79.9	139.6	73.4	74.7	" "
0:30	91.8	84.4	162.0	74.4	76.4	" "
0:35	99.7	89.5	184.5	75.6	78.9	" "
0:40	108.2	95.2	206.9	77.2	82.0	" "
0:45	117.1	101.4	227.5	79.1	85.5	" "
0:50	126.5	107.8	247.6	81.3	89.7	" "
0:55	135.9	114.2	266.3	84.4	94.3	" "
1:00	145.6	121.3	282.2	88.3	98.6	" "
1:05	154.0	127.9	295.0	92.1	103.9	" "
1:10	163.4	134.9	306.6	95.9	109.4	" "
1:15	172.4	141.7	317.4	99.8	115.2	" "
1:20	180.5	148.2	325.7	103.7	121.2	" "
1:25	188.4	154.6	334.3	107.1	127.6	" "
1:30	195.8	160.6	343.0	110.6	133.8	" "
1:35	203.1	166.5	352.3	113.8	140.2	" "
1:40	210.4	172.4	362.3	116.6	146.5	" "
1:45	217.1	177.8	371.9	118.6	152.9	" "
1:50	223.4	183.1	383.9	120.9	159.4	" "
1:55	229.5	188.0	394.9	123.3	165.8	" "
2:00	235.5	193.1	406.4	125.8	172.1	" "
2:10	247.1	202.8	432.2	131.2	184.6	" "
2:20	258.5	212.1	457.2	137.8	197.0	" "
2:30	268.9	220.7	481.7	142.5	200.9	" "
2:40	278.7	228.6	505.9	146.1	220.3	" "
2:50	287.7	236.0	527.9	150.0	231.8	" "
3:00	296.3	243.4	549.8	154.5	242.9	NONE

TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)					
	136	137	138	139	140	141
0:00	71.9	T/C out of bounds	NONE	71.7	71.6	71.6
0:05	73.1		"	71.7	72.1	71.9
0:10	78.0		"	71.8	74.8	73.1
0:15	87.6		"	72.1	80.9	76.7
0:20	102.3		"	72.5	91.1	83.3
0:25	120.7		"	73.5	104.1	92.5
0:30	141.0		"	74.8	117.4	103.7
0:35	162.2		"	76.5	131.9	115.3
0:40	183.5		"	78.6	146.7	125.9
0:45	204.0		"	81.1	160.2	140.4
0:50	223.3		"	83.9	173.4	151.9
0:55	241.2		"	87.1	188.3	163.9
1:00	254.4		"	90.5	206.2	176.1
1:05	266.9		"	94.1	220.5	185.3
1:10	277.7		"	98.2	231.1	193.9
1:15	285.4		"	102.3	242.1	203.7
1:20	292.1		"	106.6	253.1	212.8
1:25	298.4		"	110.1	264.7	220.7
1:30	304.9		"	114.1	276.7	229.7
1:35	311.1		"	118.1	287.8	237.4
1:40	317.6		"	121.9	297.1	247.4
1:45	323.9		"	123.2	307.2	254.7
1:50	331.0	160.9	"	126.0	317.5	262.4
1:55	338.9	166.8	"	128.9	328.7	270.0
2:00	346.9	171.2	"	132.4	339.0	276.6
2:10	362.2	175.8	"	140.7	357.9	289.4
2:20	379.7	180.7	"	148.6	376.3	301.0
2:30	398.2	184.5	"	155.4	395.7	314.0
2:40	418.1	186.3	"	162.4	414.3	323.1
2:50	438.0	190.6	"	169.0	431.3	329.2
3:00	461.0	195.3	NONE	175.4	448.2	339.6

TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)					
	142	168	169	217	218	219
					None	
0:00	71.7	71.7	72.5	72.5	"	72.3
0:05	71.9	72.0	73.5	72.5	"	72.4
0:10	72.8	73.2	78.3	72.7	"	72.7
0:15	75.0	76.8	87.7	72.8	"	72.9
0:20	79.4	83.4	103.4	73.2	"	73.3
0:25	86.7	93.9	123.6	73.9	"	73.7
0:30	96.0	107.3	144.3	74.6	"	74.0
0:35	107.0	122.5	164.7	75.6	"	74.6
0:40	118.5	138.5	183.8	76.8	"	74.9
0:45	130.3	154.6	202.0	77.9	"	75.4
0:50	141.7	170.5	218.3	78.9	"	76.0
0:55	152.5	185.6	232.8	80.4	"	76.6
1:00	162.9	202.3	246.9	81.3	"	77.2
1:05	172.4	213.4	257.5	82.7	"	78.1
1:10	182.0	228.5	267.8	84.0	"	78.9
1:15	191.0	243.6	275.8	85.2	"	79.8
1:20	199.5	258.3	281.4	86.7	"	81.0
1:25	207.0	272.0	286.6	88.0	"	82.0
1:30	215.0	285.2	291.9	89.4	"	82.9
1:35	222.1	296.4	297.5	90.7	"	84.0
1:40	229.7	311.5	302.1	92.3	"	85.2
1:45	237.1	323.5	306.9	93.7	"	86.0
1:50	244.6	334.8	312.7	95.1	"	87.2
1:55	252.2	344.0	318.8	96.8	"	88.6
2:00	259.8	350.5	325.6	98.0	"	89.9
2:10	275.6	362.1	341.7	101.3	"	92.9
2:20	290.6	378.4	357.6	104.1	"	95.9
2:30	305.1	395.0	372.4	107.0	"	98.6
2:40	317.0	411.8	386.9	109.3	"	102.1
2:50	327.9	428.5	399.5	111.7	"	104.8
3:00	337.5	444.1	410.9	114.6	NONE	107.2

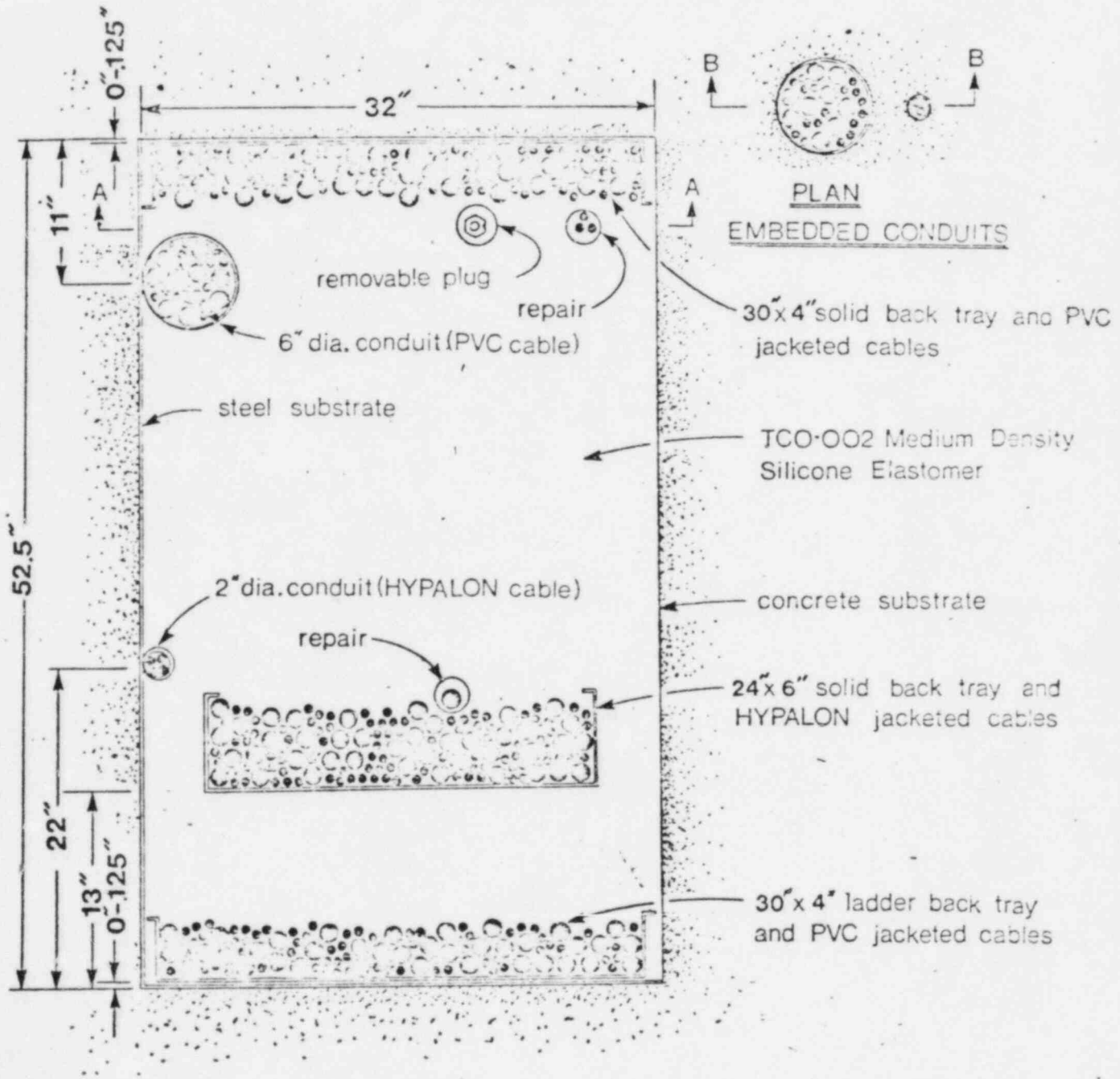
TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)					
	220	83	84	85	86	87
0:00	72.3	72.8	72.5	72.7	72.7	72.7
0:05	72.4	73.0	72.6	73.0	72.9	72.9
0:10	72.9	73.9	73.3	74.6	73.7	73.9
0:15	73.2	76.0	74.5	77.8	75.7	75.9
0:20	73.3	79.6	77.1	82.8	79.6	79.5
0:25	74.4	83.1	80.5	88.3	85.2	84.9
0:30	75.0	87.0	83.3	93.6	92.8	92.0
0:35	75.7	90.8	85.9	98.5	101.2	100.1
0:40	76.5	94.8	89.7	103.2	110.3	109.1
0:45	77.5	98.8	92.2	107.7	119.8	118.3
0:50	78.6	106.6	95.9	112.1	129.5	128.5
0:55	79.9	110.8	97.9	116.2	138.8	137.5
1:00	81.1	115.2	101.2	120.7	146.7	146.0
1:05	82.6	119.6	104.8	124.8	156.7	155.9
1:10	84.3	124.2	108.8	129.2	165.1	164.0
1:15	86.0	129.0	112.7	133.5	174.5	173.7
1:20	87.9	134.6	116.5	138.1	183.6	183.3
1:25	89.9	140.3	119.9	143.0	191.6	191.2
1:30	91.9	146.9	123.9	148.3	199.2	199.1
1:35	94.0	154.4	131.8	153.4	207.1	208.2
1:40	96.0	159.8	129.9	156.8	214.3	215.7
1:45	98.0	166.1	134.1	158.9	221.0	224.2
1:50	100.4	171.2	124.5	161.2	227.6	232.1
1:55	102.7	175.3	114.9	165.3	234.9	237.2
2:00	105.0	178.9	108.8	166.9	241.2	243.8
2:10	109.7	187.2	115.2	170.0	253.5	256.7
2:20	114.5	194.9	134.8	175.6	266.6	272.2
2:30	119.3	199.0	109.8	177.1	276.9	284.6
2:40	123.9	205.2	115.5	178.4	287.3	300.4
2:50	128.6	208.3	111.7	179.0	301.6	317.1
3:00	133.3	94.8	111.3	184.6	311.4	335.3

TEST TIME HR:MIN	THERMOCOUPLES (temperatures in degrees F)		
	88	89	90
0:00	72.6	73.3	72.5
0:05	72.8	75.7	72.8
0:10	73.8	83.8	73.8
0:15	75.8	96.5	76.4
0:20	79.6	115.3	81.3
0:25	85.4	138.0	88.4
0:30	92.5	160.5	97.2
0:35	100.4	181.7	107.1
0:40	109.2	202.0	117.5
0:45	118.1	221.6	128.1
0:50	127.4	241.3	138.7
0:55	137.0	254.5	149.3
1:00	145.8	261.6	158.6
1:05	155.9	273.6	169.9
1:10	165.6	283.0	180.4
1:15	175.4	290.7	190.3
1:20	185.6	299.0	199.7
1:25	194.3	306.5	208.6
1:30	202.8	314.2	217.4
1:35	210.1	324.0	225.8
1:40	217.7	333.8	234.0
1:45	224.9	366.2	241.9
1:50	232.1	394.6	249.5
1:55	239.6	404.4	257.1
2:00	246.8	413.9	264.0
2:10	261.0	434.6	277.5
2:20	275.7	485.6	291.0
2:30	289.7	484.0	303.0
2:40	303.8	489.6	314.9
2:50	319.3	498.2	326.8
3:00	334.8	509.4	337.6

I.) Post Test Observations:

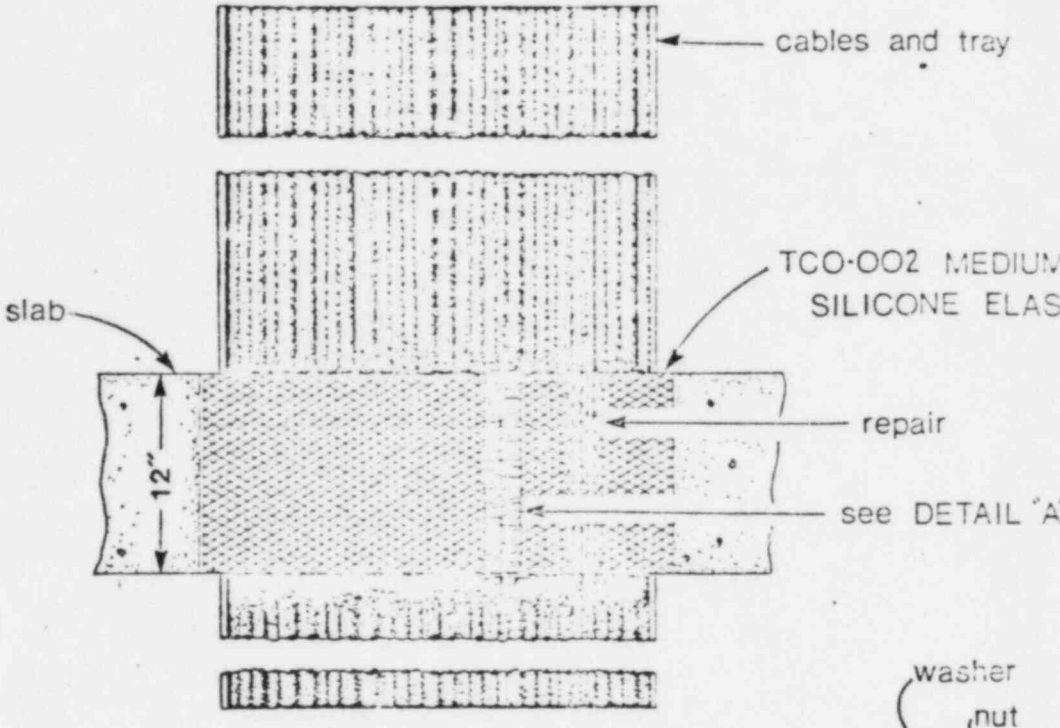
After the fire and hose stream tests it was observed that the exposed surface cable jacket materials were completely chared by the fire. The unexposed cable jackets (PVC cables only) swelled slightly near the seal surface.

The seal's exposed surface, although completely intact, formed a brittle char layer which varied 3 - 3-1/2" deep into the seal. The seal's unexposed surface was not affected.

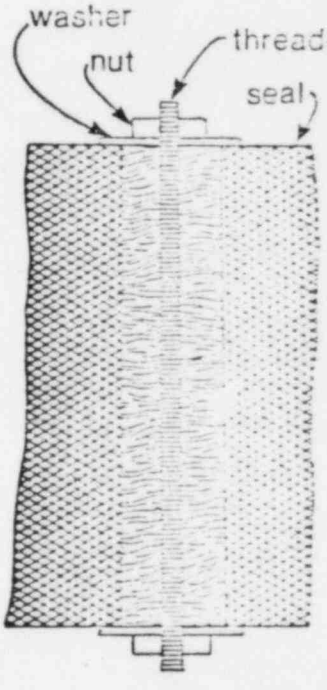


PLAN

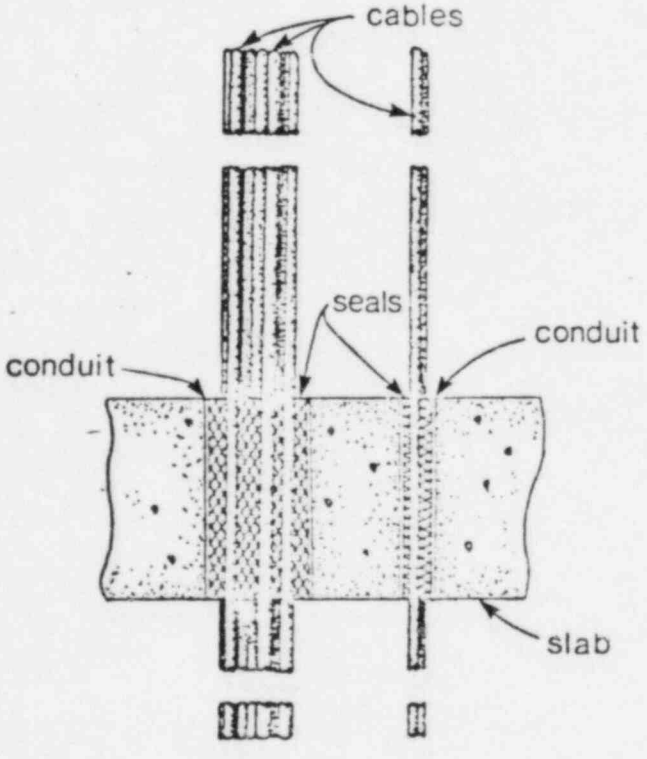
TCO-002 MEDIUM DENSITY SILICONE ELASTOMER



SECTION A-A
REPAIR & REMOVABLE PLUG



DETAIL "A"



SECTION B-B
EMBEDDED CONDUITS